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EDITORIAL

TEA CHESTS FROM LOCAL WOODS

At the Sub-Conference held at St. Coombs in 1940 one of the subjects discussed was the question of locally made tea chests. At that time attention was chiefly focussed on Albizzia chests, and a special warning was given regarding the use of wood attacked by boring insects in view of the fact that chests showing evidence of such attack were likely to be refused entry into certain countries, particularly Australia. Later events have emphasised the necessity for that warning.

At the present time, however, in view of shipping and exchange difficulties, the question of chests from local woods has assumed wider importance and it seems desirable to call attention to various points deserving of consideration.

A similar situation arose during and after the war of 1914-1918 when efforts were made to establish a local industry in tea chests. This effort eventually proved a failure, the factors chiefly responsible for this being :—

(1). Many of the woods used were highly susceptible to borer attack and the chests were condemned for this reason.

(2). Improperly seasoned woods were used.

(3). Owing to the difficulty in obtaining sufficient quantities of suitable species, chests were made up from mixed woods, some of which were likely to cause taints while others could not be securely nailed, and there were considerable variations in the weights of the chests.

As a result of these conditions local chests acquired a bad reputation on the market and the industry came to an untimely end.

The subject is referred to in Sessional Paper No. XII of 1921 (Report of the Ceylon Forest Department for 1921) and at a later date, in 1932, when the matter received further consideration a valuable report was made by Mr. F. P. Jepson of the Department of Agriculture.

In the past two or three years the subject has received much attention from the Institute and many different varieties of woods have been examined as to their suitability for tea chests, chiefly from the aspects of freedom from taint and liability to borer attack. The results very largely confirm the results recorded in Mr. Jepson's report and indicate that there are local species which with proper attention to seasoning should prove quite suitable for the purpose.

The first difficulty that arises, however, is the fact that these species do not occur in any large homogeneous blocks but are erratically and relatively thinly distributed in widely separated areas. This naturally results in increased cost of extracting and marketing the logs and imposes a considerable economic handicap on the potential industry. In fact it is doubtful whether such species at present exist in sufficient quantity to maintain a tea chest industry of any large scale. It is regrettable in view of the considerable number of years that have elapsed since the question was first raised that little or nothing has been done to remedy this state of affairs.

The question of seasoning has already been referred to. Mr. Jepson's observations and the enquiries made by the Institute clearly indicate that damage by borer attack occurs almost entirely in the log and that more modern but relatively simple methods of treatment at that stage could do much to eliminate this difficulty. Here again, however, little seems to have been done.

At a time when renewed efforts are being made to establish a tea chest industry, when a plywood factory is under construction and the possibility of making solid wood chests on a larger scale is also being considered, it is as well that the factors referred to above and other relevant problems should be further considered by the authorities responsible.

Meantime in order to protect the local industry from the bad repute it acquired during the last war it is essential that those stocking and marketing locally made chests should maintain a rigid system of inspection and firmly refuse to accept chests showing evidence of borer attack. Treatment at this stage is of little or no value as importing countries are likely to reject chests showing borer holes even though no evidence of living borers may be forthcoming.

The subject is referred to in more detail later in this issue.

HELOPELTIS

In a recent issue of the *East African Agricultural Journal* a reference is made to an observation by Kirkpatrick that the Helopeltis bug rapidly found and fed on sugar solutions. This suggested

the possible use of a poison bait. Experiments on a laboratory scale were therefore carried out in which the bug was allowed to feed on Cinchona foliage sprayed with a solution made up of 1 oz. of sodium arsenite and 5 lb. of sugar dissolved in 4 gallons of water. All the bugs were dead in 48 hours.

The application of this experiment to tea is unfortunately a less simple matter. It is obviously quite impracticable to spray tea in plucking with solutions containing arsenic owing to the risk of arsenic being carried over in the manufactured tea. The question remains whether the bugs would be attracted to or feed on a solution such as the above absorbed in, say, blotting paper placed at the base of the bush, or even possibly on a solid bait. In the experiment described above it is uncertain whether the insect directly fed on the poisoned solution or imbibed this accidentally in sucking the leaf sap. In view of the fact that no simple remedy against Helopeltis is at present available, experiments to elucidate this point might be of interest.

ASH CONTENT OF TEA

The food regulations of many countries in relation to tea impose certain limitations in regard to the ash content and the proportion of soluble to total ash. In general it may be said that the ash content is usually required to lie between limits of 4—7 per cent, and that the soluble ash must not be less than 50 per cent of the total ash.

In view of the fact that questions in regard to ash content of local teas occasionally arise, a series of ash analyses of a representative collection of Ceylon teas has recently been made and the results are recorded elsewhere in this issue. It is satisfactory to record that all the samples, which included both dry weather and monsoon teas, satisfied the conditions referred to.

SPECIMENS OF WEEDS AND GREEN MANURES

The Institute is always glad to receive from estates specimens of weeds and other plants occurring locally and which it is considered might be of use as ground covers or green manures. In order to assist in the identification of such specimens they should, wherever possible, include flowers and fruits. They should be sent wrapped in plantain leaf or moss to preserve their fresh condition, or else dried and pressed between sheets of folded newspaper.

It will be particularly appreciated if, at the same time, full particulars are given as to the conditions under which the plant is found growing, *e.g.*, elevation and in wet or dry, shady or sunny positions.

ROLAND V. NORRIS

THE CONTROL OF TEA TORTRIX BY ITS PARASITE *MACROCENTRUS HOMONAE*

C. H. GADD

Tea tortrix (*Homona coffearea*) has at various times been regarded as one of the most important pests of the tea bush. So seriously was the pest regarded in 1928 that it was officially declared a pest and the collection of egg masses was made compulsory in an attempt to control it.

In 1937, speaking on "The Tortrix Problem" at a conference, King [1] stated "For no very clear reason Tortrix as a pest is far less in evidence than it was a few years ago"; from which it seems, particularly as compulsory egg mass collecting was in force at the time, that he had doubts concerning the efficacy of egg mass collecting as a means of control.

In November, 1935, and again in September, 1936, small consignments of a small parasitic wasp, *Macrocentrus homonae*, were received from the Institute of Plant Diseases in Java and liberated in the tea area at St. Coombs. Since then, aided by a few liberations in other districts [2] *Macrocentrus* has spread extensively and is now established in all tea districts of Ceylon as a parasite of tea tortrix. "Owing to the impressive record of *Macrocentrus homonae* in rapid colonisation and ability to deal faithfully with the Tea Tortrix a recommendation was put to the Board of Agriculture to suspend the regulations with regard to the control of Tea Tortrix." [3] This was agreed to and the regulations relating to the collection and destruction of egg masses were duly rescinded on May 12th, 1939.

Tortrix as a pest is still far less in evidence than it was a few years ago. The sceptic may well ask whether the destruction of an unknown number of caterpillars by the parasite *Macrocentrus* is really more efficient in controlling tea tortrix than was the certain destruction of millions of potential caterpillars by the collection of egg masses. What he would not ask for would be the relative costs of the work done by *Macrocentrus* and by the labour force necessary to collect the egg masses at frequent intervals. The latter is self-evident, but proof of the efficacy of the parasite, apart from general observation, is not. The following data may therefore be of interest.

Since the beginning of June, 1935, tortrix caterpillars have been collected at frequent intervals at St. Coombs in order that the extent to which they had been parasitised might be determined The collections were all made by the same assistant, Mr. D. J. William, and at each collection he spent approximately the same amount of time collecting. He did not collect all the caterpillars in a given area, nor all caterpillars from a given number of bushes, as the work was designed to determine the extent of parasitism and not the intensity of attack. But it will be evident that at those times when caterpillars were abundant many would easily be collected whereas at other times there might be the greatest difficulty in collecting any at all. Nor were the collections made at very regular intervals, but when opportunity permitted. The maximum number of collections in any one month was 7 and the mean number per month was 4 over the 6-year period June, 1935, to June, 1941. By dividing the total number of caterpillars collected in any one month by the number of collections made during that month, the mean number of caterpillars per collection for that month is obtained. It is suggested that such mean numbers afford a fair index of the intensity of infestation so long as the time devoted to collection remains fairly constant.

In Fig. 1 are shown the mean monthly collections of caterpillars made over a 6-year period beginning June, 1935, from which it will be evident that in 1935 the number of caterpillars steadily increased from June till December when the peak was reached, and then decreased gradually to a minimum in June, 1936. For the year June, 1936, to June, 1937, the curve follows a similar trend, rising to a peak in February, 1937, and again falling to a minimum about the middle of the year. In the following years the general level of tortrix attack was much lower and pronounced peaks are not evident.

The graph for the two years June, 1935, to June, 1937, is typical of the seasonal history of tea tortrix as ascertained by King [1] from a study of egg mass collection data. He concluded that there were five generations per year, the smallest generation being in June and the largest about January. The drop from the January maximum was attributed to a heavy mortality in the caterpillar stage The data here examined illustrate the same point, viz. that caterpillars are most abundant from December, (1935) to February, (1937) and are at a minimum about the middle of the year, usually June. After June, 1937, the caterpillars never became abundant, rarely exceeding 20 per collection as compared with 97 in December. 1935. The February peak of 1939 is represented by 31 per collection, and the February peak of 1941 by 13 per collection. Whatever the cause may be, it is evident that tea tortrix has been adequately controlled between June, 1937, and June, 1941.

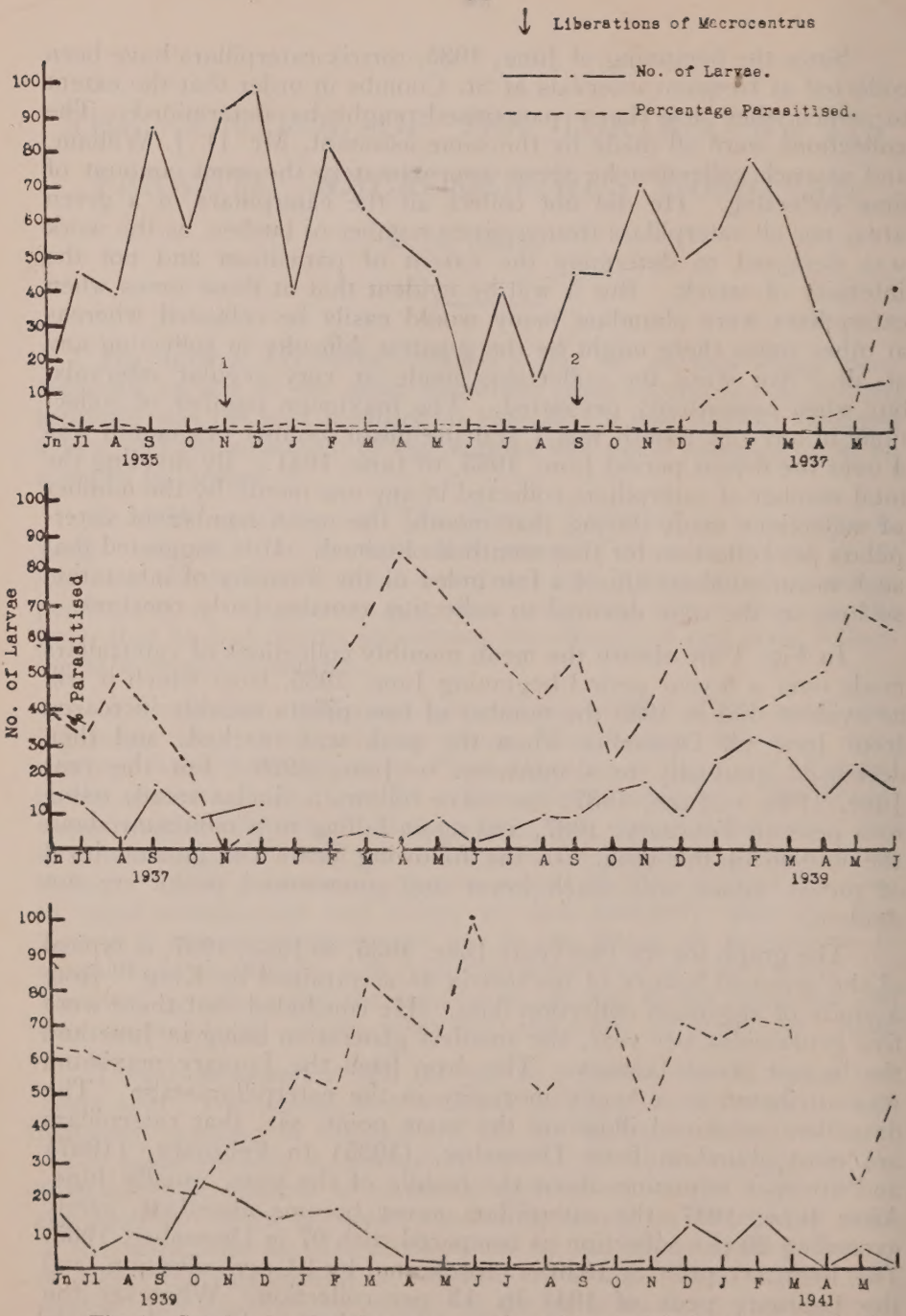

Fig. 1.—Graphs showing the mean number of tea tortrix larvae per collection during each month between June 1935 and June 1941, and the percentage of larvae parasitised by *Macrocentrus homonae*, each month.

As already stated, the real object of these investigations was to follow the activity of the parasite *Macrocentrus* in the field. The number of caterpillars found to be parasitised has been expressed as a percentage of all the caterpillars collected during each month. The results are shown in graph form also in Fig. 1. Until January, 1937, caterpillars parasitised by any parasite were counted, but after that date when *Macrocentrus* began to appear in appreciable numbers, only caterpillars parasitised by that insect were counted as parasitised. It is evident from Fig. 1 that the percentage of caterpillars parasitised by all parasites was negligible until January, 1937, when *Macrocentrus* turned up in appreciable numbers.

Small consignments of *Macrocentrus homonae* were received from Java in November, 1935, and September, 1936, and liberated in the same months. In January, 1936, one out of 152 caterpillars collected was found to be parasitised by *Macrocentrus* but the parasite was not again found till June, 1936, when one out of 45 caterpillars was parasitised. These recoveries must have been descendants of those liberated in November, 1935. In December, 1936, five caterpillars out of 240 were found to be parasitised and after that date *Macrocentrus* was found every month in which caterpillars could be found. No caterpillars could be found in July and September, 1940, and April, 1941. So there are breaks in the percentage 'parasitised' curve of Fig. 1 at those dates.

It is evident from the graphs that the decrease in the tea tortrix population was coincident with the establishment of the parasite, though that does not necessarily prove cause and effect. There are, however, very good grounds for concluding that the establishment of the parasite is the cause, and the decrease in tortrix population the effect.

No tortrix caterpillar parasitised by *Macrocentrus* ever becomes adult, and so able to reproduce its species. A high percentage of parasitism therefore means heavy mortality amongst the tortrix. The fewer tortrix that reach maturity the fewer will be the caterpillars in the next generation. Continued heavy attack by the parasite on the caterpillars must therefore result in a diminution in the caterpillar population. The graphs show that the *Macrocentrus* attack is both heavy and continuous.

A diminution in the number of caterpillars must also result in a decrease in the numbers of the parasite though not necessarily in the percentage of caterpillars parasitised. When caterpillars are few they are difficult to find, not only by the scientific collector but possibly also by the small parasite. We might expect therefore that when caterpillars are scarce, the percentage parasitised would also

be low. That however has not proved always to be the case as may be seen for the period April, 1940, to November, 1940, when caterpillars were very scarce. Yet the percentage parasitised was high. That indicates a very high efficiency of the parasite in finding its prey. Such efficiency would tend to cause any increase in the number of caterpillars to be followed by heavier attack from the parasite as every female parasite would have a better chance of finding the host and fewer would fail to raise a brood. From June, 1938, to February, 1939, there was a steady though small increase in the number of caterpillars — a normal seasonal tendency. Following this rise in number came an increasing percentage parasitised from October, 1938, which continued to a maximum in March the following year. The ability of the parasite rapidly to catch up with any increase in the number of the host in this way is an important factor tending towards effective control.

In view of such evidence it becomes apparent that the decrease in the tortrix population having occurred shortly after the establishment of *Macrocentrus* was not mere coincidence but was brought about by the activities of that parasite. *Macrocentrus homonae* has proved itself to be a highly efficient parasite, and the evidence here presented indicates that it is holding the tea tortrix in check very effectively.

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(2). — Annual Report for 1939. *T.R.I. Bull.* 21, p. 38 (1940).

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THE SELECTION OF HIGH-YIELDING TEA BUSHES FOR VEGETATIVE PROPAGATION

T. EDEN

High-yielding capacity is only one of the desirable characteristics for which one looks in attempting to improve tea planting material, but it is naturally the first to receive attention. This is so for two reasons, firstly yields are known to vary considerably from bush to bush so that real improvement is obviously possible in that direction, and secondly, yield is the most easily and directly assessed characteristic with which one has to deal.

With a crop harvested so frequently as tea, the collection of yield data is tedious, and in an ordinary field experiment the refinements of method introduced to secure accuracy in the data are well worth while despite their laborious nature. But in the selection of mother bushes for vegetative propagation, exact yield figures are of less importance. If from a field one hundred of the best bushes are chosen by eye, all that is required is that the best two or three of these hundred shall be identified by whatever further method of selection is adopted. At this stage their actual yield is of no importance.

The yield of a bush is obviously bound up with the number of flush shoots it produces. The question of interest is whether the relationship between yield and flush number is close enough to make flush counts a reasonable basis for yield selection. If so, the laborious weighing and drying of flush recommended hitherto in the Preliminary Memorandum on Tea Selection and in this journal, 1939, Vol. 12, p. 48, can be discarded. This problem has been under investigation during the past year.

Two fields were chosen and the normal procedure of selecting bushes by eye was carried out. These bushes were plucked for 40 rounds, and contrary to the plan usually adopted no discards were made. The flush was counted at every plucking, and the leaf was collected, bagged, dried and weighed, as recommended in the

Memorandum, at the end of each group of eight pluckings. The flush counts were totalled for the same periods, thus giving, in all, five sets of figures for both yield and flush count Both fields gave similar results, but the data from one only are given here in illustration of the investigation. The conclusions set forth are based on the actual yields for 40 pluckings which are taken as an exact measure of the yield capacity of the bush over an extended period.

Table I shows how the dry weight yields and flush counts of 171 busnes are distributed with regard to one another. It is noticeable that on the whole, low flush numbers correspond with low yields and high flush numbers with high yields. In each column the highest number is printed in italic type. The average value for the yield corresponding with that particular flush group will be somewhere near the yield category of that italic printed figure. For example, consider the column headed 1,501 to 2,000 flushes. Out of sixty-one bushes in that flush group just over half (31) are concentrated in one yield group and the rest fall away fairly evenly on either side. That figure thirty-one has a prepondering influence in determining the average yield of those sixty-one bushes.

TABLE I

Correlation between Total Dry Weight Yields and Corresponding Flush Counts of Individual Bushes (40 Pluckings).

Total Numbers of Bushes falling in each Category (171 total)

Dry Wt. Gm.	Numbers of Flush (grouped)							
	501 to 1,000	1,001 to 1,500	1,501 to 2,000	2,001 to 2,500	2,501 to 3,000	3,001 to 3,500	3,501 to 4,000	4,001 to 4,500
351-400							1	
301-350					1	2	*1*	1
251-300				9	10	*2*		
201-250			19	*16*	*11*	2		
151-200		11	*31*	15	3			
101-150	*2*	*18*	11	1				
51-100	1	3						

The numbers printed in italics fall roughly on a diagonal and this establishes the *general* relationship that flush count is proportional to yield. We are chiefly concerned with the top right hand corner of the table. There we find three bushes with counts above 3,500. They have yields above 300 gm., but there are also a further three bushes which fall into the same yield group. At any rate, if we had selected on flush count and had decided to choose three bushes (rather less than two per cent of the originals) we should have succeeded in choosing three out of the best six yielders. For so accurate a choice we should have had to make forty flush counts for each bush.

TABLE II

Correlation between Total Dry Weight Yields (40 pluckings) and the Corresponding Flush Counts of Individual Bushes for the first 8 Consecutive Pluckings only.

Numbers of Bushes falling into each Category (171 total)

	Numbers of Flush (grouped)										
Dry wt. Gm.	50 to 100	101 to 150	151 to 200	201 to 250	251 to 300	301 to 350	351 to 400	401 to 450	451 to 500	501 to 550	551 to 600
351-400											1
301-350								1	3		1
251-300					2	4	2	*7*	*4*	1	1
201-250			2	6	11	*12*	*12*	3	2		
151-200		3	*7*	*14*	*17*	9	7	3			
101-150	1	*5*	11	8	6		1				
51-100		1	2	1							

In Table II the same 171 bushes have been distributed according to the same total dry weight yields at the end of 40 pluckings, but the flush counts are those for the first eight pluckings only. The figures for the numbers of bushes in each category are rather more diffusely spread than in Table I, but the same general relationship

holds, and it is evident that the flush counts of the first eight pluckings give in general a very fair forecast of final yields after forty pluckings. If we pick out the best three flush counts here, we find that no fewer than 24 other bushes have yields above 250 gm. But the increments in the yield groups are rather coarse, and the position is actually better than it looks at first sight.

TABLE III

Rank of the ten best individual bushes in respect of flush count and total yield.

Dry wt. yield gm. 40 Pluckings	Rank According to Flush Count				
	At 8 Pluckings	At 16 Pluckings	At 24 Pluckings	At 32 Pluckings	At 40 Pluckings
396	1	3	3	3	3
342	2	1	1	1	1
319	5	2	2	2	2
312	11	10	5	6	9
310	9	6	6	8	8
306	25	16	12	11	13
291	83	49	31	17	34
290	78	68	78	61	64
288	4	4	8	10	15
288	23	25	26	21	19

Table III gives the ten best bushes in order to their dry weight yield at the end of 40 pluckings. The actual yields are shown in the extreme left hand column. The remaining columns give the rank of the bushes according to their flush counts at the end of 8, 16, etc., pluckings up to the final flush count at the fortieth harvest. At the eighth plucking the best 2 bushes are discernible from their flush counts and after 16 plucking rounds the best 3 are found ; a further 24 pluckings do not alter the choice. The fact that corresponding to the yield order of 1, 2, 3 the flush count order is 3, 1, 2

is of no importance: the data are to enable selection to be made for further and more stringent tests on the progeny. It is also noticeable that the three bushes separated out as agreeing in status by both methods are the only bushes of real interest from the point of yield. The difference between a 396 gm. and a 342 gm. yield is sufficient to make the former bush outstanding, and the second difference between 342 gm. and 319 gm. is also enough to make the higher yielding bush worthy of further observation. But the remaining eight bushes are grouped relatively close together and their total yield difference is only about three-fifths of the amount that separates the two best bushes. On these grounds therefore it is evident that relatively few flush counts will readily separate out the two per cent outstanding bushes from the larger number selected by eye.

The following procedure is recommended.

Record the flush counts for each mother bush and total the counts at the end of the fourth and eighth pluckings. If the bushes comprising the best two per cent are made up of the same individuals on each of these occasions, then they may be chosen for propagation. If not, then the counting must be continued for another group of four pluckings or till stability is reached. It is immaterial whether the ranking within the top two per cent remains stable. so long as no gaps occur in the order of merit.

THE TECHNIQUE OF VEGETATIVE PROPAGATION OF TEA

T. EDEN AND JESSIE BOND

Since 1939 when a short account of how to prepare rooted cuttings of tea from selected bushes was given in this journal (1939 p. 50), a good deal of experience has been gathered which has modified the technique that the Institute recommends. The original method gave very disappointing results in the hands of a number of those who tried it, and the Institute itself was not exempt from failures. It appeared to us that this was due not to any lack of care and attention on the part of the experimenters but to imperfections in the technique itself. Attention was drawn to this in the annual report for 1939 (Bulletin 21, p. 51), and an account of investigations designed to improve the method is given in the current annual report (Bulletin 22, p. 63).

Variation in climate and circumstances generally will probably make corresponding variation in technique desirable. Though we have not yet enough experience to lay down definitive methods for all occasions, the improvements attained in the last two years are sufficiently striking to warrant the publication of a revised method.

TYPE OF CUTTING

After consideration of further work on this subject, we have no alteration to make to the original recommendation that single-node cuttings are best. If a growing axillary shoot is present, it should be pinched back to its fish leaf. Both green and young red wood cuttings are capable of giving a high percentage of successes in rooting, though the material from a particular bush may show slightly superior results from red wood. Cuttings are normally successful from bushes that are in active growth, and some of the best results we have had (80—90 per cent rooting) have been derived from cuttings taken from prunings immediately after severance from the bush. Young seed-bearers where active growth had ceased. gave cuttings that were sub-normal in performance. Some bushes will always prove intractable, but poor results from a single bush do not invalidate a technique generally.

ROOTING MEDIUM

The use of peat makes cuttings easy to handle, but experience has shown that it is by no means necessary. Those who still have stocks (which are now irreplaceable owing to the war), can best use them by mixing the peat with three times its volume of soil. In the absence of peat, soil alone suffices: drain silt from a good tea field is a thoroughly satisfactory medium. *On no account should coir dust or fibre be used either plain or mixed with soil.*

INSTALLATION

The rooting is carried out in beds, which for convenience in the handling of material should not exceed 3 to 4 feet in width. Their length will depend on the number of cuttings used. The base of the bed is a 4-inch drainage layer of small road metal or of ash-free cinder or clinker. On the top of this is a 6-inch layer of the soil, or soil and peat. If building rubble is used as the drainage bed, then it must be free from mortar, otherwise there is risk of promoting an alkaline reaction in the bed. A similar risk is involved in using soil from an old building site or a line garden. Such sites are often convenient for other reasons, but if used for propagating batteries, the soil for the beds must be transported from elsewhere.

On St. Coombs we have found it convenient to excavate 10 in. of soil before making the propagation bed ; thus bringing the top of the bed to the original soil level. Conditions of drainage must influence the decision to follow this plan or to use raised beds enclosed within edging boards, concrete parapets or rough stone edges. The essential condition is excellent drainage. When watering these beds they can be thoroughly soaked and allowed to drain. We have found daily watering unnecessary. We have left cuttings for as long as a week or ten days without harm in showery weather. There is no doubt that failure in the past has frequently been due to over-watering.

The propagation bed must be consolidated both before and after insertion of the cuttings. The cuttings are inserted up to the axil of the leaf in such a way that the leaf lies as flat as possible, care being taken that the leaves do not overlap.

Sheds or frames are unnecessary: heavy ferning is better. Experience has shown that a second frequent cause of failure in rooting has been insufficient light. Scorch must of course be avoided, but attention to this has previously led to the opposite extreme. As the freshly cut fern dries and the shade it gives decreases, further additions may have to be made. Ferning should follow the insertion of cuttings immediately; the first few hours are critical.

ROOT STIMULANTS

The use of a growth regulating substance, Hortomone A, has resulted in earlier rooting, but its extensive use would entail an expenditure out of proportion to the benefit gained. In particular circumstances such as those arising from the approach of a suitable transplanting season, the hortomone treatment may be useful as an accelerator. It is not likely, in our experience, to be of any value in breaking down an inherent resistance to root formation on the part of individual bushes. When tried it should be used according to the suppliers' directions.

TIME OF TRANSFERENCE

At the end of 3—4 months a sufficient number of cuttings will normally have rooted to enable a transfer to be made to baskets ready for the field, if the weather is suitable.

The beds can be picked over subsequently about once a month till it is obvious that rooting is virtually finished. Specimens that are not rooted are replaced in the same manner. After six months it is not usually worth while to go on. By this time 80—90 per cent

should be rooted. Cuttings should be transferred to baskets with care so as not to damage roots. When raised in ferned beds, cuttings need no hardening-off, but fern must be maintained in the baskets. At this stage they are ready to go out into the field with protection baskets, but if the season is unsuitable they can be maintained in a nursery as basket plants sunk into the soil.

It may be possible at selected times to plant out cuttings straight from the rooting-bed to the field ; on the other hand, in order to eliminate any possible check in growth, it may be worth while to supersede transplanting by raising cuttings from the beginning in individual baskets. These alternatives require further testing, but for the time being the technique outlined here represents an improvement in performance and a simplification in procedure that should make it practicable without difficulty on estates.

SUMMARY OF METHOD

Cuttings.—Single node; rigid green or young red wood from bushes in active growth. If growing an axillary shoot pinch back to its fish leaf.

Beds.—6 inches of soil from drains, or soil and peat (3:1), overlying 4 inches small ashless cinder or road metal.

Installation.—Cuttings firmly inserted up to mother-leaf without overlapping. Bed heavily ferned at time of insertion.

Watering.—As required: thorough soaking needed, but daily watering is to be deprecated.

Transplanting.—At 3 to 4 months to baskets ready for field, and ferned. Careful handling to prevent root damage.

ARTIFICIAL CONTROL OF *HELOPELTIS**

The *Helopeltis* bug causes damage to a wide range of host plants, the most important in East Africa being cotton and tea. Where cacao and cinchona are grown they also are attacked. In the nursery, seedlings of avocado, mango, guava, and kapok, among others, are severely affected. As described by Harris (this Journal, Vol. 2, p. 387), the injury consists of two main types:—

(a) *On the Foliage.*—Numerous angular spots appear, first of all black, later becoming brown and more or less transparent as they dry out. Leaves severely attacked when young crumple, and the plant develops a bunching growth. Superficially these spots resemble those caused by bacteria — for example, angular leaf-spot in cotton — but with the important difference that fresh *Helopeltis* spots are never water-soaked.

(b) *On the Stems and Branches.*—First discoloured patches appear, which after a short time dry out and form rough, corky lesions. These, if large, split and form cankerlike growths as the stem becomes woody. They are to be distinguished from bacterial lesions by the fact that, until they begin to dry out, they only affect the outer layers of the stem.

It does not need a large population for conspicuous damage. It has recently been found at Amani that severe injury was caused to cinchona when the average number of *Helopeltis* present did not exceed one adult and at most two nymphs per tree. This became more understandable when it was found in the laboratory that the daily number of lesions produced by a single third-instar nymph varied between 60 and 140, with an average of 85.

In experimental work with *Helopeltis*, which is being published elsewhere, Kirkpatrick noticed that the bugs kept in the laboratory rapidly found and fed on sugar solution. This suggested the possibility that poison-bait might be effective. For the present purpose a strength of 1 oz. of sodium arsenite and 5 lb. of sugar to 4 gallons of water was the most satisfactory. When cinchona foliage

* Reprinted from *The East African Agricultural Journal*, Vol. 6, 1941, page 168.

sprayed with this solution was made accessible to *Helopeltis* in the laboratory, over 80 per cent of the bugs were dead in twenty-four hours and all the rest in forty-eight. With only $\frac{1}{2}$-oz. of sodium arsenite per 4 gallons, the immediate effect was equally good, but after a single night's dewfall the poison lost its power. A solution containing 2 oz. of sodium arsenite scorched the leaves.

Owing to a seasonal shortage of *Helopeltis* and Mr. Kirkpatrick's departure to join the forces, the experiments could not be extended to the field. His preliminary results are, however, of interest for those concerned in the control of this troublesome insect. The indications are that the best results consistent with economy of bait would be obtained by the use of a sprayer that delivered the fluid on to the foliage in the form of small droplets rather than as a fine mist.

THE MIXTURE AS BEFORE

(REVIEW)

Sir Albert Howard's latest book* starts with an inquest into the present state of world agriculture and ends with the apotheosis of the Indore Process. The argument is developed on the following lines. Humus is the basis of all soil fertility and is the product of microbial activity on the remains of dead vegetation leavened with animal remains and excreta. The process of growth and decay stabilizes the nitrogen cycle, but does more than that: it contributes something else which is ill-defined but very important. Humus has a special value apart from any effect it has on the physical state of the soil; its water retention, or its ordinary nutrient content. It encourages a symbiotic relationship between the roots of plants and a specialised form of fungal life the mycorrhiza which lives either on the outside, or in certain cases, mainly inside the root cells. On this intimate relationship the health of the plant depends and not the health of the plant only. Without it crops languish, plant diseases increase, cattle murrains, such as foot-and-mouth disease are engendered and finally man himself is affected. The surest way to destroy the mycorrhizal relationship is to use artificial manures. "Artificial manures lead inevitably to artificial nutrition, artificial food, artificial animals and finally to artificial men and

* An Agricultural Testament, A. Howard, Oxford University Press.

women" (p. 37). The best way to encourage all that is good is by the use of humus prepared by the Indore Process though there are one or two developments (*sic*) of the original method that will suffice. One of these is green manuring, provided that green manuring is accompanied by the use of animal wastes. Economics are entirely irrelevant to the needs of present day agriculture and research must be completely overhauled. "Agricultural research has been misused to make the farmer not a better producer but a more expert bandit" (p. 199).

Anyone who sets out to criticise agricultural methods is shooting at a sitting bird. There is no doubt whatever that the productivity of agricultural land particularly in new countries is being wasted by overgrazing, inefficient rotations, or by the lack of rotations, and by the general deterioration of the soil. The fact that mechanical appliances enable areas many times greater than those worked by horse or hand to be tackled, means that so much more land can be spoiled if the agricultural methods are prodigal. In Australia for instance the methods of cultivating the land are infinitely more efficient than in the days of feudal manorial farming in England, but the efficiency of the *system* into which these operations fit is not of a vastly higher order than it was in England five centuries ago.

All this Sir Albert says trenchantly and with point. It is when he turns to specific detail that one is compelled to disagree. In the first place, the picture is not so bad as it is painted. Within the last ten years there has been a drive to bring arable grassland into prominence in rotations since it is recognised that grass builds humus more quickly and more economically even than forest. A chapter is devoted to this important subject. But as a matter of fact in the last 70 years there has been a progressive increase in just this direction In England the area under rotation grasses has increased by over 20 per cent and in Scotland by nearly 27 per cent according to the yearly agricultural returns. The cattle population during the same period has increased by 50 per cent.

Then there is as yet no specific proof for the validity of the generalisation about mycorrhiza and compost. There is evidence in the book itself that green manuring is as effective as compost in promoting the relationship. Special mention is made of the remarkable mycorrhizal growth on Crotalaria at Waldemar. This was prior to any composting being carried out on that estate. The interesting history of sugar cane rearing at Shahjahanpur which is given in full in chapter 14 leads to a system which when introduced to the villages was based on green manuring alone. No real evidence is brought forward for the connection between quality of crop and compost or mycorrhiza. Harris at Cambridge has failed

to find improvement as a result of using bulk manure and Viswanath at Delhi has just reported results in contradiction of those previously claimed. We are in fact moving in the realm of interesting speculation that will need much detailed work before the essential ideas are clarified. After describing the mycorrhizal association on page 25 the following passage occurs:—

> "How this association influences the work of the green leaf is one of the most interesting problems science has now to investigate. Is the effective synthesis of carbohydrates and proteins in the green leaf dependent on the digestion products of these soil fungi? It is more than probable that this must prove the case. Are these digestion products at the root of disease resistance and quality ? It would appear so. If this is the case it would follow that on the efficiency of this mycorrhizal association the health and well-being of mankind must depend "

This is the language of hypotheses not of proof, but the rest of the book is written as if that proof were a settled thing.

There are a few definite mis-statements. One is as follows:—

> "Two views have been and are still being held on the best way to manure tea. One school of thought, which includes the tea research institutes, considers that as the yield of leaf is directly influenced by the supply of combined nitrogen in the soil, the problem of soil fertility is so simple as to reduce itself to the use of the cheapest form of artificial manure — in this case sulphate of ammonia."

As a statement of the Tea Research Institute's views this seemed so strange and unfamiliar that the writer of this review examined the articles he has written in the last twelve years in this journal. They number fifty in all: of these only fourteen deal with artificial fertilizers: twenty-two advocate methods of green manuring and soil conservation, whilst the balance of fourteen is devoted to other topics such as cultivation.

To those who have kept abreast of compost literature the contents of this book will be recognised as "The Mixture as Before." There is much in it that is informative and interesting including some shrewd opinions It is a pity that the case for composting should not have been stated with moderation and persuasiveness. It is slightly ridiculous to find a description of outdoor milk farming culminate in so egotistical a sentence as "The stage was set for the Indore Process" (p. 199). As it is, a stimulating book is marred by ungenerous statements and peevishness.—T. Eden.

TEA IN RELATION TO FOOD AND DRUG REGULATIONS

I.—ASH CONTENTS

J. LAMB

In a recent article [1] the implications of Food and Drug Regulations with respect to tea were briefly outlined.

The ash content of a product such as tea offers the analyst a convenient way of checking adulteration and fraud particularly in cases liable to occur in wartime when high prices or rationing make adulteration profitable. Adulteration by means of, say, spent leaves would reduce both the total ash and, in particular, the soluble ash since the brewing of tea removes soluble minerals and any considerable adulteration would at once be indicated by examination of the ash. Likewise the incorporation of grit or sand to make up weight, or of lime to increase the colour of inferior tea, or tea adulterated by spent leaves, would be detected on account of high total ash content with a correspondingly low soluble ash content.

During the last war a double form of adulteration was practised in which grit and vegetable matter was incorporated with spent leaves by means of rolling in a moist condition. On drying, the adulteration was not easily discernible to the eye when this product was mixed with genuine tea in proportions up to 20 per cent. Other means are available for confirming adulteration but the determination of ash contents is a convenient routine method of detecting adulteration.

Such methods must be based on fairly accurate knowledge of the natural variation of ash contents. The mineral matter in the leaf of any plant is liable to vary with growth conditions. The ash content of tea appears to be dependent upon elevation at which the leaf is grown and upon rainfall, and there is little doubt that soil conditions are an important factor. Abnormal growth conditions may, and in fact do, occasionally cause genuine teas to be questioned by food and drug authorities although within our experience, other characters have enabled the doubt to be removed.

Detailed knowledge of the range of ash contents of genuine teas grown under various conditions is therefore of value to the Tea Industry, and since we have collected a good deal of information on this subject we now publish the figures so that these characters of genuine Ceylon teas may be on record.

1. ELEVATION

Teas grown at high elevations appear to have a lower ash content than those grown at low elevations. Table I shows the ash contents of B.O.P's from different elevations produced under similar weather conditions.

TABLE I

	% Ash Content	
	Total	Soluble
1. Nuwara Eliya District	4.88	3.21
2. Dimbula and Dickoya District	5.27	3.32
	5.41	3.30
	5.22	3.33
	5.07	3.40
3. Kelani Valley	6.46	4.37

2. WEATHER AND SOIL CONDITIONS

Table II shows the ash content of teas grown mainly between 3,000 and 4,000 feet on the South West side of the Island during the South West Monsoon, whilst Table III shows similar figures for the Uva Province during dry weather. Both sets of figures are roughly comparable on the basis of elevation.

The average total ash content is slightly higher in the teas grown under dry conditions, whilst there are considerable variations in the figures in each table which are presumably due to different soil conditions in the various districts in which the teas were grown. The ash contents of the O.P's are markedly higher than those of B.O.P's indicating that stalky teas are liable to contain higher amounts of ash than leaf grades. Teas made from tipping leaf did not show any marked variation from the normal.

TABLE II

S. W. Monsoon Conditions

Estate No.	Ash Percentage on Dry Weight					
	B.O.P			O.P.		
	Total	Soluble	% Soluble of Total	Total	Soluble	% Soluble of Total
1	4·28	2·70	63·1	—	—	—
2	5·13	3·30	64·3	4·59	2·95	64·3
3	5·00	3·14	62·8	5·78	3·66	63·3
4	4·80	2·97	61·9	5·43	3·30	60.8
5	4·98	3·00	60·2	5·93	3·93	66·3
6	4·91	2·94	59·9	5·42	3·36	62·7
7	4·78	3·28	68·6	5·59	3·79	67·8
8	4·43	3·19	72.0	5·42	3·40	62·7
9	5·17	3·38	65·4	6·17	3·85	62·4
10	4·90	3·36	68·6	5·10	2·87	56·3
11	4·84	3·07	63·4	5·11	3·42	66·9
12	5·14	3·59	69·8	5·09	3·51	69·0
13	4·53	2·68	59·2	5·01	2·75	54·9
14	4·58	2 67	58·3	5·15	3·13	60·8
15	5·11	2·93	57·3	—	—	—
16	5·22	3·09	59.2	5·43	3·52	64·8
17	4·21	2·52	59.9	4·65	3·21	69·0
Average	4·83	3·05	63·2	5·33	3·38	63·5

TABLE III

Dry, Windy Conditions

Estate No.	Ash Percentage on Dry Weight					
	B.O.P.			O.P.		
	Total	Soluble	% Soluble of Total	Total	Soluble	% Soluble of Total
18	5·06	3·39	67·0	—	—	—
19	5·32	3·37	63·3	5·66	3·56	62·9
20	5·00	3·15	63·0	5·60	3·63	64·8
21	5·07	3·07	60·6	5·76	3·72	64·6
22	4·77	2·45	51·4	4·77	3·32	69·6
23	5·47	3·26	59·6	5·83	3·41	58·5
24	5·09	3·04	59·7	5·77	4·07	70·5
25	4·93	2·94	59·6	5·67	3·53	62·3
26	5·19	3·19	61·5	—	—	—
27	5·51	3·52	63·9	6·09	4·36	71·6
28	5·51	3·22	58·4	5·69	3·26	57·3
29	4·99	2·69	53·9	5·72	3·27	57·2
30	4·35	2·45	56·3	5·67	3·47	61·2
31	4·73	2·60	55·0	5·77	3·80	65·9
32	5.24	3·49	66·6	5·63	3·97	70·5
Average	5·08	3·06	60·0	5·66	3·64	64·4

SUMMARY AND CONCLUSION

The ash contents of a number of Ceylon teas produced under a wide range of conditions has been investigated in order to determine the variation which may be expected in the ash contents of genuine Ceylon teas. Taking round figures and thereby allowing margins for exceptional cases we arrived at the following characteristics:—

1. Total ash is not less than 4 per cent and not more than 7 per cent of the dry weight of tea.
2. Soluble ash is not less than 2 per cent and not more than 5 per cent of the dry weight of tea. Expressed as a ratio to total ash the soluble ash varies between 50 per cent and 70 per cent.

REFERENCE

1. *Tea Quarterly* 1941, XIV, 76.

QUESTIONS REGARDING THE LOCAL SUPPLY OF TEA CHESTS AND FIREWOOD FOR ESTATES

J. LAMB

That the financial stability and relative prospertiy of Ceylon has depended for many years upon the Tea Industry nobody will deny. Apart from all political issues the tea industry is therefore entitled, in the common interest, to expect support from any other local industry which may serve its needs. Major industries often give rise to subsidiary undertakings which, working in unison, may make most useful contributions to the welfare of a country as an organised unit. Industrialisation in primarily agricultural countries is indeed a much sounder proposition when based on the needs of its primary industries rather than on wartime economy or purely secondary requirements selected at random. Successful competition with highly organised industrial countries without the aid of the kind of protection which merely "robs Peter to pay Paul" is however a matter of careful planning and foresight combined with rigorous supervision of standards of quality.

Two needs of the tea industry which offer great possibilities for local development are those of Tea Chests and Fuel. The tea industry may quite fairly call upon the Forestry Department and

the Department of Commerce and Industries for greater attention to its needs and the present moment seems an opportune one to indicate once more the directions in which assistance is urgently required.

What are the prospects of supply from local sources of suitable tea chests, either plywood or momi type, and what is the position with regard to firewood supplies either from forest reserves or from fuel blocks to be worked by estates and replanted with approved species? A recent statement in the local press gave the impression that the new plywood factory which was to have supplied tea chests will not fulfil this original purpose. The same report stated that the manufacture of momi type tea chests was to be undertaken at the same factory. The tea industry would welcome information about the quality of such momi type chests and also about the possible scale of supply.

The cost of firewood to up-country estates is mounting rapidly. In normal times firewood of good quality is easily the cheapest form of fuel available to the tea industry and imported fuels owe whatever popularity they possess to the organisation and efficient salesmanship of fuel importers.

In wartime, when the supply of imported fuels is uncertain, is the cost of firewood to be allowed to rise to the level of imported fuels? Have the possibilities of fuel shortages been envisaged?

Forestry in Ceylon no doubt presents its problems but there appears to be little reason why many of the difficulties in the way of local tea chest production and the provision of firewood for estate use should not be overcome.

TEA CHESTS

Taken in order, the main requirements for tea chests are:—

1. Strength and durability.
2. Freedom from taints and borers.
3. Lightness of weight and evenness of tare.

White woods make packages of rather better appearance than dark or coloured woods but this is not a really important point.

There are a number of Ceylon timbers which make very satisfactory tea chests. Samples of chests manufactured locally have been tested at the Tea Research Institute and have compared very favourably with imported chests of Japanese origin. Amongst these timbers is *Albizzia moluccana* grown in mid and up-country districts

as high shade for tea and where its growth is rapid without however deleterious effects upon the firm texture of the timber. Such rapidly growing species appear to offer possibilities for the establishment of stands of timber, specially for a tea chest industry, but at the present moment the main concern must be the amount of suitable material already available in accessible areas. The establishment of a plywood factory and the press reports regarding the proposed manufacture of momi type chests suggest that this question has been investigated and that considerable amounts of suitable species of timber are available.

Definite information about the position with regard to possible supplies of local tea chests would however be of considerable interest to the tea industry at the present moment, for many difficulties are being experienced in the supply of good quality chests and should the position in the Far East lead to a complete severance of trade relations with Japan the position might easily become very serious.

A policy of drift appears to have been followed in the matter of local tea chests and, once again, as in the last war of 1914-18 and the years of disorganisation immediately following the war, the local tea chest industry is being strangled by exploitation. While the price of chests is high, village carpenters make tea chests out of anything which comes to hand. Mr. F. P. Jepson in a report to the Director of Agriculture dated 1932 records a case of a local chest being constituted of six different species of timber including a piece of pine from an imported packing case. Most of the difficulties have been understood at least since 1922 for the Report of the Industries Commission, Sessional Paper I of 1922, contains many references to problems of the local chest industry. The report says: "Forestry is an industry which in a country like Ceylon should only rank second to agriculture in importance. This Island is the natural home of many valuable woods and it should be at least self-supporting in regard to timber used in various industries." Mr. P. M. Lushington's remarks in Sessional Paper XII of 1921 are also quoted "The forests have been drained to make revenue and very little has hitherto been spent on improvement and development."

Further quotations from Mr. Lushington are directly concerned with packing chests: "At present we are dependent upon other countries to the sum of Rs. 3,000,000 annually for tea box woods." Mr. Lushington states: "there is no need for Ceylon to go outside the country for her supply" and indicates on page 22 of his report (*vide* above) how the demand could be met locally.

The position in 1922 was summarised in the following words: "At present there are three distinct interests concerned in the manufacture of tea chests. The grower, (*i.e.*, the Forestry Department), at least one middleman who manufactures the chest, and the user There is no machinery for linking up these three classes, no organisation for ensuring (1) that the demands of users of tea chests can be completely supplied locally, and (2) that the tea chests are made in accordance with the requirements of the tea trade The Forestry Department is indifferent to the demands for tea box woods and the manufacturer is indifferent to the requirements of the user. The result is that the Tea Traders accept the situation and import their tea chests from other countries." It is to meet such a situation that we advocate very strongly the establishment of a Bureau of Industry and Commerce. Without such a bureau we cannot see how the various sub-industries concerned in a simple large industry can be satisfactorily linked together.

The position in 1941 is much the same; the bureau which has now been established has failed to set up the machinery necessary to link together the three classes concerned in the manufacture of tea chests. A golden opportunity exists to establish a local tea chest industry if only on a small scale, but history is repeating itself and the low quality of chests now produced is bringing the local product into disrepute.

A rather different point of view was expressed by Mr. J. D. Sargent who wrote as Acting Conservator of Forests in 1919: "Tea Chests. This belongs to reafforestation entirely, after selection of the most suitable species. These are not in sufficient quantity for the three-ply trade, and the fact that Ceylon contains no pure or gregarious forests of suitable species renders the collection of such timber expensive and prevents competition with the imported article. The remedy is reafforestation in accessible areas with easy transport facilities."

Since 1919 there has been ample time for the establishment of suitable rapid growing species. The view seems, however, to have been adopted that considerable quantities of timber are available or else the plywood factory would not, presumably, have been built.

The general level of prices prevailing in the tea chest market should also widen the radius of economic accessbility referred to by Mr. Sargent whilst the importation of timber in the log could probably be relied upon to make up deficits in supplies until such time as suitable local timber is available in sufficient quantity at competitive prices. If a tea chest industry had been established as

recommended in the reports quoted, the tea industry would by now have had an assured supply of chests at a reasonable cost and, by reason of the revenue it provides, the tea industry should receive consideration of such needs as a matter of policy.

At this stage it is important to realise that the indifference of the tea industry to such local chests as have been produced has, in the main, been due to the very poor quality of the local product. Two main factors are responsible for this poorness of quality. They are local ignorance and prejudices about the most important matter of seasoning and careless exposure of timber to borer attack

Soon after the outbreak of War Mr. C. B. Redman King, the Institute's Entomologist, and the writer together made a tour of some of the local production centres with the object of obtaining information for advisory purposes. It rapidly became obvious that although some merchants were producing sound articles the industry would soon fall into disrepute unless some control were exercised over the market as a whole, designed to eliminate chests made from unseasoned and borer infested timber.

Mention has already been made of the admirable report by Mr F. P. Jepson, Assistant Entomologist, Department of Agriculture, dated August 1932, made at the conclusion of similar investigations. The report is very detailed and full of useful information The general conclusion which Mr. Jepson arrived at was confirmed almost exactly by our experience in 1939.

Borer infestation appears to take place mostly in the freshly felled log. The commonest types of borer are attracted by the sugary (simple carbohydrates) material in the moribund tissues of the log and, until this attraction is removed by seasoning, almost all timbers are susceptible to borer attack. Some woods appear to be particularly susceptible and these together with other timbers unsuitable for other reasons are black listed in the reports quoted above. A number of species, however, after seasoning appear to lose their attraction for boring insects, presumably for the simple reason that the soluble foodstuffs have been removed and nothing but indigestible highly lignified material remains. Furthermore, incomplete removal of these sugary materials apart from attracting beetles is liable to give rise to mould growths on the timber and to attendant offensive odours arising from fermentation. Obnoxious products of fermentation are liable to remain in timber for considerable periods of time and to taint the contents of packages constructed from such badly seasoned materials.

Seasoning, according to the reports quoted and to our own observations does not appear to be taken very seriously in Ceylon. Ignorance or prejudice may result in the wrong choice of methods or indifference to quality may result in its neglect. At the present moment the latter course is the one most likely to be adopted by village carpenters interested in a quick turnover.

The seasoning of timbers to be utilised for simple purposes such as packing case construction does not appear to be a very complicated process. Judging from the reports available, the following sequence of events results in the production of satisfactory materials for packing cases:—

1. The freshly felled log should be peeled immediately after felling. This is apparently extremely important but most often neglected in Ceylon.

2. As soon as possible the dressed log should be transported to the nearest stream and *completely* immersed in running water. Logs left lying about are very subject to borer attack. This is the commonest stage of infection and probably the only one of economic importance. Felled logs usually have to await arrangements (and often flood water in rivers) for transport. It is during this time that they should be completely submerged to protect them from borer infestation and to obtain even seasoning. Stagnant pools are not suitable because of the accumulation of fermentable matter and the formation of obnoxious products liable to cause taints.

3. After floating or otherwise transporting to the saw mills logs should again be completely immersed to complete the seasoning process. Floating timber does not season properly. Eventually, the soluble materials are leached out completely from the timbers suitable for tea chest manufacture and the timber no longer attracts boring beetles to any marked extent.

4. After thorough drying the timber is ready for use. Planks after sawing should be thoroughly dried under cover but in a free flow of air.

More rapid methods of dissolving out the soluble carbohydrates also appear to be available and one method, apparently quite suitable, is to saw up the logs and steam the planks in airtight tanks. This is said to complete seasoning in a period of a few days only.

There appears to be plenty of information on the subject of seasoning and there are no doubt a number of people in the Island competent to advise on the matter. The main difficulty is one of supervision to ensure that nothing but the best seasoned and borer-free material finds its way into chests to be used for exporting tea. Any system of Government supervision must be in the forest, for inspection of made up chests though useful in preventing the distribution of inferior articles can be of little further use. The most radical solutions of the difficulties undoubtedly are to be found in Government owned or licensed saw mills and a system of trademarks enabling the tracking down of defaulters.

The authorities I have quoted are of the opinion that attention to seasoning would result in evenness of the tare of tea chests because the timber would be of even composition and would dry evenly. Obviously, chests made of several different species of timber must be eliminated entirely. A further point in this connection has been rather overlooked and should receive consideration. Difficulties sometimes arise in the Customs because of differences in weight between the tare marked on the chest and the Customs own measurement. This may be due to either rise of moisture content of the tea, the timber or both. Chests are commonly dried out before packing and are particularly liable to increase in weight after packing in wet weather if the drying out process has been too severe. It is common practice in Ceylon to season in brackish water and although salt hardens the timber it also makes it very liable to absorb excessive amounts of moisture and may give rise to considerable trouble between exporters and the Customs authorities. Table I shows figures obtained for weights of imported chests under various conditions.

TABLE I

Figures obtained with imported chests.

	Weight of chest
1	
(a) Large chest dry	18 lb. 8 oz.
(b) Large chest after storage in damp atmosphere (21 days)	19 lb. 4 oz.
2.	
(a) Large chest freshly made up	18 lb. 10 oz.
(b) Large chest after storage in dry atmosphere (21 days)	17 lb. 14 oz.

Finally, before passing on to the subject of fuels there are one or two aspects of the local tea chest industry which require special emphasis.

There has been a tendency for would-be inventors to seek ways and means of either killing borers in their galleries or rendering timber borer proof by impregnation with chemical agents. We have been approached to test methods of this nature. It must be fully realised that the mere presence of borer holes in tea chests imported into countries with stringent regulations is in itself sufficient to cause rejection of both chest and contents. Ceylon exporters have been warned by certain authorities that chests and tea will be thrown into the sea if borer infested material is sent to ports within their jurisdiction. Such authorities would not accept any statement to the effect that the borers had been killed by Mr. X's patent process. The so-called borer proofing is only likely to be a doubtful substitute for proper seasoning and any success in deterring borer attack might be nullified by trouble with fungus attack and taint, unevenness of tare and all the other difficulties arising from the use of unseasoned wood.

The same considerations are likely to apply to plywoods and it is quite probable that the presence of borer galleries in plywood chests would be regarded just as unfavourably as those in momi type chests.

This point is specially emphasised because plywoods made from Ceylon timber were recently submitted to us for tests. The plywoods were all quite free of odour and did not impart any taints to teas packed in them. The strength and appearance were quite up to the standard of most imported plywoods, but many were badly riddled with borer galleries as shown in the following table

TABLE II

	1st chest.	2nd	3rd	4th	5th	6th	7th	8th
1. Aridda	0	0	0	0	0	0	0	0
2. Del	25	15	11	30	24	22	19	12
3. Etamba	3	1	10	1	3	0	8	11
4. Kekuna	0	0	0	0	1	2	0	0
5. Katuboda	0	1	0	0	7	0	5	3
6. Keena	0	0	0	8	10	21	20	7
7. Kirehemibiliya	6	10	3	5	27	14	21	0
8. Malaboda	0	0	1	1	19	27	0	0
9. Thiniya	0	0	0	0	2	0	0	0

In conclusion, therefore, it is quite plain that the question of boring insects and seasoning must be taken seriously before a local tea chest industry can be developed. Suitable species of timber grow readily in Ceylon and much information is available both for planning immediate utilisation and for developments in the planting of future supplies. The industry must, however, be organised and a vigorous policy in connection with advisory and supervisory activities should be initiated as soon as possible.

Reasons have been given why such organisation must embrace the whole production process from the time the timber is felled.

FUEL

During 1936 a series of articles was published in *The Tea Quarterly* (Vol. IX) under the title of "Studies on Fuels for Tea Driers." The concluding paragraph of the fourth article of the series points out the value of locally grown firewood as a fuel for the tea industry. "While local industry can produce red gum or similar firewood at Rs. 4 per yard or until imported fuels are reduced considerably in price, firewood growing must be a sound economic proposition. The suggestion is ventured that insufficient attention has been given to this aspect of the tea industry and, in view of the closing of Government fuel blocks in many parts of the Island, a thorough revision of the local fuel growing industry is desirable."

A ready reckoner based on careful tests carried out in St. Coombs Factory was also published in this article and it is of interest to use this to compare the relative costs of heating air with firewood, oil and coal at the present moment.

Table III expresses the relative costs of firing by the various means at present available at St. Coombs Factory. In this table all the costs are expressed as multiples of firewood costs.

The ready reckoner enables similar figures to be worked out for any estate by a few simple calculations. At present costs the upper limits fall short of requirements but to supplement the table is only a matter of simple arithmetic.

Table III contains figures for coke which are worked out on the assumption that its heat value is roughly the same as coal. Coke was not used in our original tests but subsequent experience leads us to make this assumption However, the cost of coal and coke is practically prohibitive so long as firewood is available. Oil at current contract price is approximately twice as expensive as firewood.

The firewood on which the comparison is based consists mainly of close textured, heavy species weighing about 650-700 lb. per air

dry yard. Obviously, light open-textured wood weighing only 400 lb. per yard would be just as expensive as oil if Rs 4.00 per yard were paid for firewood having only half the weight of combustible matter in it.

TABLE III

Comparisons of Costs of Firing with various Fuels delivered at St. Coombs Factory.

Fuel	Cost of fuel	Cost of heating stove to working temperature.	Cost of heating air.
Firewood	Rs. 4 per yard (650-700 lb. air dry)	1.0 Taken as unit cost	1.0
Oil	43 cts. per gallon		
(a) Low pressure burner		2.2 units	3.3 units
(b) High pressure burner		2.2 ,,	4.6 ,,
Oil at contract price 37 cts. per gall.			
(a) Low pressure burner		1.9 ,,	2.8 ,,
(b) High pressure burner		1.9 ,,	4.0 ,,
Coal	Rs. 64.65 per ton	3.6 ,,	3.8 ,,
Coal and coke	(Coke at Rs. 46.25 per ton)		
(a) 3:1		3.3 ,,	3.5 ,,
(b) 2:1		3.2 ,,	3.4 ,,
(c) 1:1		3.1 ,,	3.3 ,,

When comparing the cost of firewood with other fuels it is therefore most important to state the weight per yard because the value of wood as fuel depends on weight. Light open-textured woods such as Toonah, Albizzia, Dadap, Rubber, etc., are all almost twice as expensive for fuel as Red Gum, Blue Gum, Acacia, up-country jungle firewood, etc., if the same rate per yard (air dried)

is paid irrespective of weight. Old gum trees may weigh up to 1,000 lb. per yard as compared to under 400 lb. for young albizzia or for rubber.

The evaluation of firewood by weight is however confused by the moisture content. Freshly felled firewood contains roughly 50 per cent moisture and on this account weighs considerably more (30 per cent more) than air dry fuel which contains only 20 per cent of moisture. Tests have shown that firewood split and stacked under cover (overhead only) will dry down to 20 per cent moisture in two months and that in very dry weather the moisture content will fall to 11 per cent in six months. The stable figure for moisture in firewood is however 20 per cent and it should always be dried down to this figure before use. Damp firewood causes low thermal efficiency, and trouble with condensation in the stoves of the driers, which may lead to costly repairs. Finally, to obtain efficient combustion, firewood should be cut into short lengths of about one foot. This enables the grate to be covered evenly and the draught to be distributed evenly throughout the whole area of combustion. As many estates can now testify, the cost of a circular saw for cutting firewood into small pieces is saved on fuel economy in the space of two or three years according to the scale of working.

As we have pointed out before in *The Tea Quarterly*, the virtues of firewood as a fuel for tea driers are often lost sight of since there are not any very large organisations interested in its sale. One virtue, that of growing at our back doors, may however be brought home to us if the supply of imported fuels is seriously affected by the war. There are great possibilities in an organised local fuel industry but, like local tea chests, local fuel is inclined to be compared unfavourably with imported fuel owing to indifference to quality and lack of organisation. Firewood contractors are interested only in a quick turnover and the last cent of profit. Many up country tea estates are forced to buy from firewood contractors working Government fuel blocks. The demand for firewood is increasing and the price is rising with the demand. In some districts it is difficult to buy firewood at all and it appears desirable that the whole question of fuel supply should be investigated with care and without delay.

Since the bulky nature of firewood is its chief drawback, tending to make transport costs rise out of all proportion to its cost of production and since the cost of transport is also steadily rising it is becoming imperative to organise supplies. The transport of any material containing 50 per cent of useless water is obviously uneconomical yet firewood contractors almost habitually supply freshly felled

firewood. The cost of transport is charged to the buyer and the contractor is indifferent to the fact that he is transporting 50 per cent water. Since the bulky nature may impede the fullest use of weight carrying capacity in transport, it is also obviously important that firewood should be cut into short lengths to facilitate packing The contractor's main interest in this connection usually appears to be the fullest use of irregularities in shape and size in order to get the least possible amount of material into the measured yard. On account of these difficulties the quality of local fuels would be improved by the establishment of depôts in fuel producing areas or at main distribution centres where fuel could be cut and air dried under rough cover before transporting to estates or other consumers. It would also be in the interest of a local fuel industry to sell light open-textured wood at a lower rate per yard than the denser species and gradually to eliminate them from firewood plantations.

The great advantage of locally produced fuel over imported fuel is that transport distances may be reduced by buying from the nearest source of supply. The greatest advantage should therefore be taken of the widespread distribution of jungle firewood and so long as reafforestation with suitable species follows immediately on the cutting of the firewood there does not appear to be any real objection to the working of fuel blocks by estates willing to replant with approved species, by approved forestry methods.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD 24-7-41

Minutes of a Meeting of the Board of the Tea Research Institute of Ceylon held at the Ceylon Chamber of Commerce Rooms, Colombo, on Thursday, the 24th July, 1941, at 2-30 p.m.

Present.—T. B. Panabokke, Adigar, (Chairman), the Chairman, Planters' Association of Ceylon, (Mr. D E. Hamilton), the Chairman, Ceylon Estates Proprietary Association, (Mr. C. H. Bois), Mr. R. G. Coombe, Major J. W. Oldfield, C.M.G., O.B.E., M.C. Messrs. J. D. Hoare, S. F. H. Perera, W H. Gourlay, G. K Newton, R. P. Gaddum and Dr. R. V. Norris (Director, T R I. and Secretary).

(1). The Notice convening the meeting was read.

(2). The Minutes of the Meeting of the Board held on the 4th April, 1941. were confirmed after a minor correction to lines 1 and 3 of Item 5(d) where "drying" room was substituted for Rolling Room.

A letter was tabled from the Director of Agriculture regretting inability to be present.

3. MEMBERSHIP OF THE BOARD AND COMMITTEES

There were no changes to record.

4. FINANCE

(I) T. R. I. ACCOUNTS FOR HALF YEAR ENDING 30TH JUNE, 1941

These had been circulated to members. The Chairman commented on the more favourable position due to heavier recent receipts from tea sales and the cess.

Estate Working Account.—This showed a profit of Rs. 20,517 as against a deficit of Rs. 17,044 at the end of May and a deficit of Rs. 13,758 at the corresponding date in 1940. It was reported that in addition there were some 25,000 lb. of made tea in Colombo awaiting shipment.

Revenue Account.—Receipts from the cess had improved but at 30th June were approximately Rs. 10,000 less than at same date in 1940. The surplus on revenue account at Rs. 78,034 was however higher by Rs. 25,313.

Cash Position.—Rs. 82,000 was on fixed deposit of which Rs. 75,000 represented sums required for payments against the Government Loan to be made in September and the balance the Furlough and Passages Reserve. Investments at cost stood at Rs 141,875.

Cash on current account amounted to Rs. 91,884 against which there were liabilities of approximately Rs. 10,000. In addition a sum of Rs. 42,492 being cess for June was due from the Collector of Customs (since received).

(II) INVESTMENTS.

The Chairman said it had not since the last meeting been possible to make further investments as until the present month the balance on current account had been under Rs. 30,000. Recent heavy receipts had now changed the position as indicated above. A sum of approximately Rs. 40,000 was required for capital expenditure in the second half of the year and he thought a further sum of Rs. 50,000 could now be invested.

The Board sanctioned investment of this sum in the Government of Ceylon 2½ per cent War Loan.

The Accounts to 30th June were approved.

At the request of Mr. Coombe, the Director said he would give details of tea sales and average prices realised in subsequent statements.

5. ST. COOMBS ESTATE

(I) VISITING AGENT'S REPORT DATED 23RD JUNE, 1941

Manuring.—In reply to Mr. Perera, the Director said there was no reason to think nitrogen applications were inadequate. The yield for the first six months of the year worked out at 417 lb. per acre. It would be possible to obtain data in regard to higher nitrogen applications from some of the manurial experimental plots.

Mr. Hoare commented on the proportion of phosphoric acid in the estate mixture which he thought was somewhat high in relation to nitrogen.

In reply to Mr. Gaddum and Mr. Hamilton the .Chairman explained that the estimate for the new estate lines had been very carefully scrutinised by the Finance Committee and approved both by that Committee and the full Board.

In reply to Mr. Hamilton, the Director said the question of the drainage of the experimental area in the 1938 clearings was under discussion with the Agricultural Chemist.

Replying to Mr. Gaddum, the Director said that he had no information available with regard to the suitability of wild sunflower as a green manure plant for clearings. It was now being given a trial on St. Coombs clearing owing to the difficulty experienced in establishing other species.

(II) STORM DAMAGE

It was reported that considerable damage had occurred on St. Coombs Estate on the 23rd May, when exceptionally heavy rainfall occurred. Members were referred to the Minutes of the Experimental Committee (page 5) in which further details were given.

The Board noted that the cost of making good this damage on the estate was likely to cost about Rs. 1,500.

On the research side the Director said the main pipe line had been breached in 5 places and cost of repairs amounted to Rs. 306. The most serious trouble was the destruction of the bridge leading

to the Subordinate Staff quarters and the only means of now dealing with this was the construction of a wire bridge of about 120 feet span. The cost of this was provisionally estimated at Rs. 1,250.

Some doubts were expressed as to whether this sum would be adequate owing to the swampy nature of the ground and the difficulty of securing good foundations. Ultimately it was decided to give the Director discretion to exceed the above estimate if found necessary.

6. MINUTES OF THE MEETING OF THE ESTATE AND EXPERIMENTAL SUB-COMMITTEE HELD ON 12TH JULY, 1941

Comments were invited.

Mr. Hoare said he did not consider that climatic conditions alone were responsible for the recent increase in weeds experienced by estates and still thought that the use of groundnut cake had something to do with this.

The Director said the Institute had found no evidence that weed seed were introduced in this manure. He would however endeavour to obtain comparative data in regard to weeds in the manurial plots.

The Board approved the recommendation of the Committee that a sum of Rs. 300 be allowed under Estate Capital Account for purchase of a hand cart.

The Minutes of the Experimental Committee Meeting were recorded.

7. SENIOR SCIENTIFIC STAFF

Reported that Dr. T Eden, Agricultural Chemist, had returned from long leave and resumed duties on the 15th July.

8. JUNIOR SCIENTIFIC STAFF

(a). *Mr. B. T. Schuiling*.—Reported that the balance of the loan given to this officer for the purchase of a car had now been repaid in full.

(b). The Board confirmed the following salary increments:—

(i). Mr. H. B. Sreerangachar Rs. 20 per mensem as from 15th July.

(ii). Mr. F. D. Tillekeratne Rs. 20 per mensem as from 15th September.

(iii). Mr. R. L. Illankoon Rs. 20 per mensem as from 1st October.

9. SUBORDINATE STAFF—COST OF LIVING

The Board further considered the position of the Institute's Subordinate Staff (Laboratory attenders, telephone operators and similar officers) — all on salaries below Rs. 100 per mensem).

The Board decided that in view of the further increase in the cost of rice and other necessities some relief should be given and sanctioned payment as a temporary measure of a special allowance to these officers equivalent to 5 per cent of salary in the case of unmarried staff and 10 per cent of salary in the case of married members. These allowances will not be taken into account in calculating Provident Fund contributions.

10. UTILISATION OF VACANT SENIOR STAFF BUNGALOW AND GUEST HOUSE

The Director said it was possible No. 3 Senior Staff bungalow, at present occupied by Mrs. King, might shortly be vacant.

The Board decided this bungalow might be leased at the discretion of the Director on a monthly rental of Rs. 100 plus Rs. 10 for electric light and Rs. 2 for telephone connection. Any lease should be terminable at one month's notice.

The Director also asked if the Board would consider the utilisation of the Guest House for convalescent members of the combatant forces for whom accommodation might be required.

The Director was instructed to make enquiries from the Naval and Military Authorities as to the need for such accommodation. It was also considered that if the Guest House were used in this manner, one room should in any case be kept free for the use of visitors to the Institute.

11. RESEARCH IN THE LOW-COUNTRY

The Director said he had received a letter from the Southern Province Planters' Association enquiring as to whether there was any likelihood of the Institute setting up a Sub-Station in the Low-Country in the near future. He had replied, provisionally, that in view of the uncertain position due to the war he thought the Board would be unable to commit itself to further recurring expenditure at the present time. He had suggested however that he should attend a meeting of the Southern Province Planters' Association to hear their views on the question.

In discussion it was pointed out that it was the policy of the Board, subject to financial considerations, to establish sub-stations though it would be preferable that such should not be on private land.

Mr. Coombe considered that in estimating the Institute's future financial requirements Low-Country claims would be sympathetically considered by the Associations concerned.

On the motion of Mr. Bois, seconded by Mr. Perera, the Director was instructed to draw up a Memorandum on the subject for discussion in the first place by the Experimental Sub-Committee. The views of the Committee, if approved in principle by the Board, would then be submitted to District Planters' Associations in the low-country for comment.

12 TRAINING OF CEYLONESE STUDENTS AT THE RESEARCH INSTITUTES

It was reported that the motion on this subject which had been pending for some time in the Central Board of Agriculture had not yet been discussed.

13. ANY OTHER BUSINESS

It was reported that owing to war conditions the Tea Scientific Conference which was to have been held in S. India in August, and which Dr. Gadd had been deputed to attend, would not now take place.

The Meeting terminated with a vote of thanks to the Chair.

ROLAND V. NORRIS,
Secretary.

NOTICES.

The Institute's Laboratories and Offices are situated at St. Coombs, Talawakelle, and all applications and enquiries should be addressed to the Director, Tea Research Institute, St. Coombs, Talawakelle.

Specimens and other consignments sent by rail should be forwarded to Talawakelle Station c/o Messrs. M. Y. Hemachandra & Co., Forwarding Agents. *Carriage should be pre-paid.*

Visitors' Days.—The *second* and *last* Wednesdays in each month have been set aside as Visitors' Days at St. Coombs Estate, and also at the T. R. I. Sub-Station, Gonakelle Estate, Passara, when it is hoped anyone interested will visit the Stations.

Visitors at other times are welcomed, but it is requested that an appointment be made if possible.

RULES FOR THE OCCUPATION OF ST. COOMBS GUEST HOUSE

(1). The Guest House is normally intended for the use of persons visiting the Institute and St. Coombs Estate on business. Children can in no circumstances be accommodated.

(2). Permission to occupy a room for the night must be obtained from the Director in writing and, unless sufficient notice be given, accommodation cannot be guaranteed. Two double rooms are available for the use of visitors accompanied by their wives.

(3). All visitors must sign the Visitors' Book on arrival.

(4). A bedroom may not be occupied for more than one night if required by another visitor. This shall not apply to Members of the Board or of Committees meeting at St. Coombs who shall also be entitled to priority in the allocation of accommodation when on official business.

(5). Complaints or suggestions shall be entered in the book provided for the purpose and not made to the Guest House Staff. All payments due for services rendered shall be made in *cash* to the steward-in-charge and a receipt obtained from him on the official form. The scale of approved charges is posted in the building. The steward is forbidden to give credit or to accept cheques.

(6). Liquor is supplied for consumption *in the premises only*.

(7). The Institute accepts no responsibility for cash, jewellery or other valuables of any kind left in the Guest House.

(8). All breakages will be charged for at cost price.

ROLAND V. NORRIS,
Director.

The Tea Research Institute of Ceylon.

BOARD OF CONTROL

(A) Representing the Planters' Association of Ceylon:—

(1) Mr. R. G. Coombe

(2) Mr. James Forbes (on leave), Mr. G. K. Newton (acting).

(3) Mr. J. D. Hoare

(B) Representing the Ceylon Estates Proprietary Association:—

(4) Major J. W. Oldfield, C.M.G., O.B.E., M.C.

(5) Mr. I. L. Cameron (on leave) Mr. W. H. Gourlay (acting)

(6) Mr. J. C. Kelly (on leave) Mr. R. P. Gaddum (acting)

(C) Representing the Low-Country Products' Association:—

(7) Mr. S. F. H. Perera

(D) Representing the Small-Holders:—

(8) Mr. T. B. Panabokke, First Adigar (Chairman)

(E) Ex-Officio Members:—

(9) The Hon. the Financial Secretary

(10) The Director of Agriculture

(11) The Chairman, Planters' Association of Ceylon

(12) The Chairman, Ceylon Estates Proprietary Association

Secretary, Roland V. Norris, D.Sc., St. Coombs, Talawakelle.

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The publications of the Tea Research Institute will be sent, free of charge, to Superintendents of Ceylon tea estates, over 10 acres in extent, and to Estate Agencies dealing with Ceylon tea, if they register their names and addresses with *the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle.*

Other persons can obtain the publications of the Institute on application to the Director, the subscription being Rupees fifteen per annum for persons resident in Ceylon or India, and £1-5-0 for those resident elsewhere. Single numbers of *The Tea Quarterly* can be obtained for Rs. 2·50 or 4*s*. In the case of Indian cheques four annas should be added to cover commission.